Look on the Bright Side:

Positivity Bias Modulates Interference Effects in the Simon Task

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Abstract

Negative faces are detected more quickly but categorized more slowly than positive faces. Using a Simon task, we examined stimulus- and response-related processes of this dissociation: if negative stimuli are both processed and responded to more quickly than positive ones, they should elicit reduced Simon effects. Conversely, if negative stimuli are processed more quickly but responded to more slowly, enlarged Simon effects should occur. Consistent with the first possibility, negative stimuli showed reduced Simon effects. Unexpectedly, this reduction transferred to neutral stimuli (arrows and pointing hands) requiring the same response as negative faces. This pattern suggests that spatial attention became biased toward the side associated with a positive-face response and away from the side associated with a negative-face response, demonstrating that, similar to higher level cognitive decision processes, even early attentional processes can be subject to a positivity bias ("Pollyanna effect").

Introduction

Social integration – one of the most fundamental human motivations (Baumeister & Leary, 1995) – requires that we respond appropriately to the emotions of others. Consequently, the processing of emotional facial expressions is presumed to be mediated by evolutionary hard-wired, extremely rapid neural mechanisms (see, e.g., Palermo & Rhodes, 2007, for a review).

Arguably, the expressions with greatest relevance for immediate survival are those linked to potential threat (i.e., negatively-valenced emotions). Relative to faces with positive expressions, these are detected more rapidly (Eastwood, Smilek, & Merikle, 2001; but see Calvo & Nummenmaa, 2008, 2011), hold attention for longer (Fox, Russo, & Dutton, 2002), and are more difficult to ignore (Blagrove & Watson, 2010, 2014). Already at early (perceptual) processing stages, negatively-valenced expressions are associated with increased neural activity, irrespective of participants' intentions (Rellecke, Sommer, & Schacht, 2012; Santesso et al., 2007), suggesting the existence of a threat-related perceptual processing bias.

However, despite being *detected* more rapidly, negative expressions are typically *categorized* less quickly and accurately than positive ones (e.g., Calvo & Beltrán, 2013; Kirita & Endo, 1995). This might be because positive expressions are characterized by a unique set of features, whereas various negative expressions share features, requiring further processing in order to be distinguished from each other (Calvo & Beltrán, 2013). Alternatively (or in addition) people might be generally more willing to respond to positive stimuli, and more reluctant to respond to negative ones. This has been confirmed both for words (de la Vega, de Filippis, Lachmair, Dudschig, & Kaup, 2012; O'Shea, Watson, & Brown, 2016) and for facial expressions: 'approach' responses are faster than 'avoidance' (withdrawal) responses for positive expressions, with the reverse being the case for negative expressions (Mogg & Bradley, 1999; Roelofs, Minelli, Mars, van Peer, & Toni, 2009).

Our study investigated the potential interplay between these conflicting tendencies (early perceptual negativity bias vs. late response-related positivity bias) using the Simon task, in which speeded responses are made to a target's identity, irrespective of its location. Relative to trials in which target location and response location match, performance is impaired when they mismatch. This 'Simon effect' is typically attributed to motor activations triggered automatically by the target's location (de Jong, Liang, & Lauber, 1994; Kornblum, Hasbroucq, & Osman, 1990). When target identity and location mismatch, controlled target-related activation has to overcome the incorrect location-triggered activation, producing slower correct responses and increased errors. Consequently, Simon effect magnitude is influenced by the relative timing of automatic, location-triggered activation, and controlled, target-related activation. If target-related activation develops slowly, location-triggered activation will have advanced substantially before controlled processes 'take over', resulting in large Simon effects. If it develops quickly, interference from location-triggered activation will be more time-limited, resulting in smaller Simon effects. Thus if negative faces are processed faster than positive faces, and also elicit their corresponding response faster ('negativity advantage', as suggested by the stimulus detection literature), then negative-face Simon effects should be *smaller* than positive-face ones. However, if negative faces are processed faster, but trigger their corresponding motor response more slowly ('negativity avoidance', as suggested by the stimulus identification literature), then negative-face Simon effects should be *larger* than positive-face ones.

Conversely, positive faces might drive relative effect magnitude: if responses to positive faces are generated only slowly (negativity advantage/positivity disadvantage), they should show larger Simon effects, whereas if responses to positive faces are generated quickly (negativity avoidance/positivity approach), they should elicit smaller Simon effects than negative faces. In order to determine whether Simon effect magnitude was influenced by

negative or by positive facial expressions (or both), an emotionally neutral condition was introduced using directional arrows (Experiment 1) and hands (Experiment 2).

Experiment 1

Method

Participants. Two participants' data were excluded (error rates > 30%), leaving 24 participants (12 male; 4 left-handed), 17-49 years of age (M = 21.1, SD = 6.5), with normal or corrected-to-normal vision. Half were tested individually, half in groups of three or four.

Stimuli and apparatus. We used schematic face stimuli to minimize complications from expression ambiguity and lack of standardization associated with variations in photographic stimuli (Frischen, Eastwood, & Smilek, 2008). Target stimuli were positive ('happy') and negative ('sad') faces, and left- and right-pointing arrows inside a circle (Figure 1a). Stimuli subtended a visual angle of approximately 3.0º × 3.0º at a viewing distance of 60 cm. A central fixation cross (0.5º × 0.5º) was present continuously throughout each block of trials. Stimuli were presented in black on a white background, on a laptop (individual testing) or PC screen (group testing).

Procedure. The experiments comprised five blocks of 64 trials each, preceded by two 24-trial practice blocks. In each trial, one of the four targets was presented 12º to the left or right of fixation (Figure 1b). Participants were instructed to respond quickly and accurately to stimulus identity, ignoring stimulus location. Stimulus-response mapping for arrows was always spatially congruent (e.g., left-pointing arrow - left-hand response). Mapping for faces was counterbalanced ('sad' face left-hand response, 'happy' face right-hand response, or *vice versa*). The four targets (positive/negative face, left/right arrow) and two locations (left/right) were equiprobable and randomized within each block, resulting in 50% congruent trials (target location at response hand) and 50% incongruent trials (target location opposite to response hand). In the first practice block, targets were presented for 500 ms, and the inter-trial-

interval (ITI) was 2500 ms; in the second practice block and in the experimental blocks, targets were presented for 250 ms, and the ITI was 1450 ms.

Data analysis. Trials were split into 8 conditions: 2 target types (arrow, face) × 2 congruencies (congruent, incongruent) × 2 valences (positive, negative – for arrows, this was determined by whether they were associated with the same response hand as the positive or the negative face). For RTs, only correct responses following a correct response were included (78.8% of all trials), to minimize contamination from post-error slowing. RTs and arcsine-transformed error rates were analyzed using repeated measures ANOVAs, with the within-subject factors target type, congruency, and valence, and the between-subject factor SR-mapping (positive-right, positive-left). Follow-up analyses were conducted in the form of *t*-tests and the Bayesian equivalent with three Cauchy prior widths (0.5, 0.707, and 1.0).[1]

Results

There were no reliable effects of SR-mapping on either RTs or error rates (main effects and interactions, all Fs < 2.1, all ps > .16). Consequently, this factor was dropped, and data from both mapping groups analyzed together (see Figure 2).

Responses were faster for arrows than faces, $F(1, 23) = 113.97$, $p < .001$, $MSe = 2374.26$, and faster on congruent than incongruent trials (Simon effect), $F(1, 23) = 16.51$, $p < .001$, $MSe = 896.76$. In contrast, there was no difference between 'positive' and 'negative' responses for either arrows or faces (main effect of valence, Target Type × Valence interaction: both Fs < 1). Simon effects for arrows and faces were of similar magnitude (Target Type × Congruency interaction: $F < 1$). Valence significantly modulated Simon effects (Congruency × Valence interaction, $F(1, 23) = 11.98$, $p = .003$, $MSe = 755.18$), with substantially larger Simon effects for positive than negative items (31 ms vs. 6 ms). Surprisingly, this difference was not further modulated by target type, $F < 1$. Bayesian

analysis provided moderate evidence that valence-related modulations of the Simon effect did not differ for arrow and face stimuli (BF_{10} = 0.316, 0.239, 0.175).

Error rates largely mirrored RT results, with fewer errors on arrow than on face trials, $F(1, 23) = 29.78$, $p < .001$, $MSe = 0.024$, and on congruent than on incongruent trials (Simon effect), $F(1, 22) = 9.18$, $p = .006$, $MSe = 0.010$, but no difference between 'positive' and 'negative' responses (main effect of valence, Target Type × Valence interaction: both $Fs < 1$). Like RT Simon effects, error-rate Simon effects were larger for positive than for negative items, $F(1, 23) = 8.75$, $p = .007$, $MSe = 0.002$. However, in contrast to RTs, this valence-related modulation was significantly larger for faces than for arrows, $F(1, 23) = 5.34$, $p = .030$, $MSe = 0.003$.

The finding that for RTs, a valence-related modulation of Simon effects seems to transfer from face to non-face stimuli is both novel and unexpected, and thus merits an attempt at replication. Moreover, it would be interesting if such transfer is restricted to highly over-learned, virtually automatically processed stimuli like arrows, or whether the same occurs for stimuli requiring more effortful processing (i.e., under conditions where the RT difference between the two target types is less pronounced). Experiment 2 addressed these issues.

Experiment 2

Method

The experiment was identical to Experiment 1 except that left- or right-pointing hands were used instead of arrows (Figure 1c). To avoid introducing a further congruency factor, we used line drawings that did not contain any features identifying a left or a right hand (see Figure 1c); hand stimuli were the same size as face stimuli.

Power analyses based on Experiment 1 indicated a required sample size of 24. Excluding three participants with error rates > 30% left 24 participants (none had participated

in Experiment 1), 12 in each response mapping group. Two further participants (both from the positive-left SR-mapping group) were excluded due to excessive incongruent trial errors (> 55% on one or more incongruent condition), leaving 22 participants (3 male; 5 left-handed), aged 18-30 years (M = 20.8, SD = 3.3).

Results

Initial analyses again revealed no main effect of, or interaction with, SR-mapping for either RTs or error rates (all Fs < 3.7, all ps > .07), hence all subsequent analyses were conducted collapsed across SR-mapping groups.

Results replicated those of Experiment 1 completely for RTs, and partially for error rates. Responses were again faster to non-face (hand) than to face stimuli, $F(1, 21) = 6.95$, $p = .015$, $MSe = 639.36$, although this difference was substantially smaller than in Experiment 1 (10 vs. 75 ms). Responses were faster on congruent than on incongruent trials, $F(1, 21) = 10.43$, $p = .004$, $MSe = 1226.16$, and this Simon effect was larger for face than for hand stimuli, evidenced by a significant Target Type × Valence interaction, $F(1, 21) = 5.14$, $p = .034$, $MSE = 380.66$. Again, there were no significant differences between 'positive' and 'negative' responses for either target type (main effect of valence, Valence × Target Type interaction: both Fs < 3.7, both ps > .075). Importantly, the Simon effect was again substantially larger for stimuli associated with the positive-face response than for stimuli associated with the negative-face response (31 ms vs. 4 ms, respectively), indicated by a highly significant Valence × Congruency interaction, $F(1, 21) = 8.34$, $p = .008$, $MSe = 1069.53$, which did not differ for face and hand stimuli (Target Type × Valence × Congruency: $F < 1$). Bayesian analysis provided anecdotal evidence for the null hypothesis ($BF_{10} = 0.315, 0.237, 0.175$).

Error rates were higher for face than for hand stimuli, $F(1, 21) = 21.78$, $p < .001$, $MSe = 0.008$, and higher on incongruent than on congruent trials, $F(1, 21) = 25.95$, $p < .00$, $MSe =$

0.007). These two factors interacted, with larger Simon effects for face than for hand stimuli, $F(1, 21) = 19.32$, $p < .00$, $MSe = 0.0031$. Again, there was no main effect of valence, nor a Valence × Target Type interaction (both Fs < 1, both ps > .37). In contrast to Experiment 1, the 3-way Valence × Target Type x Congruency interaction was not significant, $F < 1$.

General Discussion

Our study investigated the effect of stimulus valence on response selection and execution in a Simon task. We hypothesized that if negatively-valenced stimuli are processed more quickly than positively-valenced ones and also result in faster activation of their corresponding response ('negativity advantage'), then Simon effects for these stimuli should be *smaller* than Simon effects for positively-valenced stimuli. Conversely, if negatively-valenced stimuli, despite being processed more quickly than positively valenced ones, result in slower response activation ('negativity avoidance'), then Simon effects for these stimuli should be *larger* than Simon effects for positively-valenced stimuli.

Our results revealed that Simon effects for negatively-valenced ('sad') faces were substantially smaller than for positively-valenced ('happy') faces, supporting the negativity advantage hypothesis. Surprisingly, however, this RT modulation occurred not only for valenced face targets, but also for non-valenced arrow targets: arrows associated with the same response as negatively-valenced faces ('negative arrows') produced substantially smaller Simon effects than arrows associated with the same response as positively-valenced faces ('positive arrows'). Moreover, this effect was of the same magnitude for arrows and faces. Experiment 2, using left- and right-pointing hands instead of arrows, replicated these results. Bayesian analysis using combined data from both experiments further provided moderate evidence that face and non-face stimuli show similar valence-related modulations of the Simon effect ($BF_{10} = 0.261, 0.193, 0.140$).

This result cannot be explained easily by a negativity advantage: For this, one would have to assume that inherently non-valenced (arrow/hand) stimuli gain a positive or negative valence via associative learning. However, as they are never directly paired with face stimuli, this association would have to be indirect, mediated by the 'valence' of the corresponding response. There is, however, no evidence that the responses themselves acquired any valence: if one response had become more aversive, it should be slower than the other. Yet there were no main effects of valence in either experiment (all Fs < 1), and Bayesian analysis provided anecdotal evidence for the null hypothesis (BF_{10} = 0.591, 0.458, 0.342).

An alternative and more parsimonious explanation is that the effect reflects an attentional bias not linked to specific stimuli, but rather to a specific location. As responses were associated both with a particular valence (via task instructions) and a particular location (as demonstrated by the Simon effect), valence and location might have become associated with each other (e.g., if positive faces require a right-hand and negative faces a left-hand response, the right side of the screen might have become the positive 'happy side', the left side the negative 'sad side'). Our results then suggest a persistent attentional bias away from the negative and toward the positive side such that *all* stimuli – happy, sad, or non-face – will be processed more quickly when appearing on the 'positive side' than when appearing on the 'negative side'. As the positive side is the congruent side for positive faces and 'positive' arrows/hands, but the incongruent side for negative faces and 'negative' arrows/hands, such an attentional bias would cause valence-related modulations of Simon effects even without valence-related differences in stimulus processing. To rephrase: for positive faces and 'positive' arrows/hands, appearing at their congruent location means appearing inside the attended field, and appearing at their incongruent location means appearing outside of it. For negative faces and 'negative' arrows/hands, the reverse is true. Because attention speeds processing (Hawkins et al., 1990), congruent positive faces and arrows thus have a double

advantage (fast, location-driven automatic motor activation plus extra attentional enhancement, leading to particularly fast congruent responses; Figure 4, top left), whereas incongruent positive faces and arrows have a double disadvantage (to-be-overcome location-driven activation of the incorrect response and lack of attentional enhancement, leading to particularly slow incongruent responses; Figure 4, top right). Together, these produce enlarged Simon effects (Figure 4, center). Conversely, for negative faces and arrows, the advantage of appearing at the congruent location is offset by the disadvantage of appearing outside the attended field (making congruent responses slower than usual; Figure 4, bottom left), while the disadvantage of appearing at the incongruent location is offset by the advantage of appearing within the attended field (making incongruent responses faster than usual; Figure 4, bottom right), overall resulting in reduced Simon effects (Figure 4, center).

Of course it is potentially problematic to postulate the existence of two independent processes (spatial attentional bias and automatic response activation) of conveniently similar magnitude that either act in the same direction, increasing the Simon effect, or in opposite directions, reducing or even cancelling it, without any direct supporting evidence. Whereas the presence of automatic response activation is demonstrated by the Simon effect, directly demonstrating the presence of the hypothesized spatial attentional bias will require dedicated experimental paradigms (e.g., dot-probe detection tasks; MacLeod, Matthews, & Tata, 1986) that are beyond the scope of the present paper. However, the attentional bias hypothesis does make a specific and as yet untested prediction about RTs in the present task: if attention is preferentially allocated to the side associated with the positive response, then overall, responses should be faster to stimuli appearing at this side compared with the other, unattended side. To test this prediction, we re-coded the data (pooled across experiments) according to presentation location rather than congruency (i.e., positive congruent and negative incongruent stimuli all appear on the ‘positive side’, negative congruent and positive

incongruent stimuli appear on the 'negative side'). A repeated measures ANOVA with SR-mapping (positive left, positive right) as a between-subject factor, and stimulus type (face, non-face), stimulus valence (positive, negative), and presentation location (positive side, negative side) as within-subject factors, confirmed a small (14 ms) but highly significant positive-side advantage, $F(1, 44) = 19.13$, $p < .001$, $MSe = 220.40$. This effect was modulated by stimulus type, $F(1, 44) = 26.14$, $p < .001$, $MSe = 1054.08$, as only positive stimuli produced a significant positive-side advantage, $F(1, 44) = 38.71$, $p < .001$, $MSe = 1143.26$, whereas responses to negative stimuli were unaffected by presentation side, $F < 1$ (i.e., only positive stimuli, not negative stimuli, produced a Simon effect). There was no main effect of SR-mapping, nor an interaction between location and mapping, both Fs < 1.3, both ps > .27, and Figure 5 correspondingly shows the data collapsed across SR-mapping groups. Bayesian analysis (collapsed across stimulus valence) provided extremely strong evidence for the positive-side advantage (BF_{10} = 361.4, 360.8, and 325.7), and anecdotal support that this effect does not differ between SR-mapping groups (BF_{10} = 0.582, 0.476, 0.373).

Note, though, that the 'attentional bias' hypothesis does not apply to the error results (i.e., little to no valence modulation of Simon effects), as the bulk of errors in the Simon task are either (1) pre-attentive (fast responses triggered by the stimulus location, which produce the basic error-rate Simon effect; e.g., Stürmer & Leuthold, 2003; also Schlaghecken & Martini, 2012), or (2) due to lapses of attention (causing accidental stimulus misidentification/miscategorization; these are typically slow, unsystematic, and produce little or no Simon effect). Consequently, error rates in a Simon task are less likely to be modulated by attentional biases than are RTs. Why such a modulation was observed for face targets in Experiment 1 has to remain unresolved at this point: the fact that the effect did not replicate in Experiment 2 suggests that it might have been a spurious result.

In sum, our results suggest that when responses to positive and negative stimuli are assigned to opposite hands, they produce an attentional bias toward their corresponding spatial location, improving stimulus identification and/or response selection for stimuli presented at that location. This finding of an attentional bias toward 'the positive' – a 'Pollyanna Effect' (for a review, see Matlin, 2004) – complements the finding of framing or optimism biases in other higher-level cognitive domains (reviewed by Kühberger, 1998). For instance, in the implicit association task, positive descriptors elicit more rapid responses than do negative ones (O'Brien, Hunter, & Banks, 2007), and in judgment tasks, glasses are more likely to be described as 'half full' than as 'half empty' (Peterson, 2000). Such biases are thought to reflect linguistic 'markedness' according to valence/neutrality (Leech, 2006; Clark, 1969), and cognitive resources devoted to minimizing negative experiences and promoting positive ones (Taylor & Brown, 1994). Our findings suggest that in addition to high-level cognition, a positivity bias can modulate relatively low-level visual processing through response-mediated attentional mechanisms. We might speculate that such spatial biasing could influence what information is prioritized for subsequent processing, thus adjusting higher-level decision-making processes to current emotional 'settings', and that individual differences in these 'settings' (e.g., in state or trait anxiety) might correspondingly be reflected in differences in valence-induced attentional bias.

Note, however, that the proposed 'positivity bias' favoring the positive-response side, might instead be described as a 'negativity bias' away from the negative-response side. Similarly, we used the general terms 'positivity/negativity' despite using only specific (happy/sad) facial expressions. We are thus unable to determine whether non-facial positive/negative stimuli would indeed produce the same effect. Resolving these issues will require future research.

Footnote

[1]The Bayesian analysis, conducted using the JASP computer package (Love et al., 2015), provides a Bayes Factor (BF_{10}) which indicates the extent to which the alternative or the null hypothesis is supported (Bayes Factors of > 1 or < 1 respectively; Jarosz & Wiley, 2014). A BF_{10} of 5 indicates that the alternative hypothesis is 5 times more likely than the null, a value of 0.2 indicates that the null is 5 times more likely than the alternative.

References

Baumeister, R. F., & Leary, M. R. (1995). The need to belong: Desire for interpersonal attachments as a fundamental human motivation. *Psychological Bulleting, 117*, 497-529.

Blagrove, E., & Watson, D. G. (2010). Visual marking and facial affect: Can an emotional face be ignored? *Emotion, 10*, 147-168.

Blagrove, E., & Watson, D. G. (2014). Ignoring real faces: Effects of valence, threat, and salience. *Attention, Perception & Psychophysics, 76*, 725-745.

Calvo, M. G., & Beltrán, D. (2013). Recognition advantage of happy faces: Tracing the neurocognitive processes. *Neuropsychologia, 51*, 2051–2060.

Calvo, M. G., & Nummenmaa, L. (2008). Detection of emotional faces: Salient physical features guide effective visual search. *Journal of Experimental Psychology: General, 137*, 471-494

Calvo, M. G., & Nummenmaa, L. (2011). Time course of discrimination between emotional facial expressions: The role of visual saliency. *Vision Research, 51*, 1751-1759.

Clark, H. H. (1969). Linguistic processes in deductive reasoning. *Psychological Review, 76*, 387-404. http://dx.doi.org/10.1037/h0027578

de Jong, R., Liang, C.-C., & Lauber, E. (1994). Conditional and unconditional automaticity: A dual process model of the effect of spatial stimulus-response correspondence. *Journal of Experimental Psychology: Human Perception and Performance, 20,* 731–750.

de la Vega, I., de Filippis, M., Lachmair, M., Dudschig, D., & Kaup, B. (2012). Emotional valence and physical space: Limits of interaction. *Journal of Experimental Psychology: Human Perception and Performance, 38*, 375-385.

Eastwood, J.D., Smilek, D., & Merikle, P.M. (2001). Differential attentional guidance by unattended faces expressing positive and negative emotion. *Perception & Psychophysics, 63*, 1004-1013.

Fox, E., Russo, R., & Dutton, K. (2002). Attentional bias for threat: Evidence for delayed disengagement from emotional faces. *Cognition & Emotion, 16*, 335-379.

Frischen, A., Eastwood, J. D., & Smilek, D. (2008). Visual search for faces with emotional expressions. *Psychological Bulletin, 134*, 662-676.

Hawkins, H. L., Hillyard, S. A., Luck, S. J., Downing, C. J., Moloua, M., & Woodward, D. P. (1990). Visual attention modulates signal detectability. *Journal of Experimental Psychology: Human Perception and Performance, 16,* 802-811.doi 10.1037/0096-1523.16.4.802

Jarosz, A. F., & Wiley, J. (2014). What are the odds? A practical guide to computing and reporting Bayes factors. *The Journal of Problem Solving, 7*, 2-9. doi:10.7771/1932-6246.1167

Kirita, T., & Endo, M. (1995). Happy face advantage in recognizing facial expressions. *Acta Psychologica, 89,* 149-163.

Kornblum, S., Hasbroucq, T., & Osman, A. (1990). Dimensional overlap: Cognitive basis for stimulus-response compatibility – A model and taxonomy. *Psychological Review, 97*, 253-270.

Kühberger, A. (1998). The influence of framing on risky decisions: A meta-analysis. *Organizational Behavior and Human Decision Processes, 75*, 23-55. http://dx.doi.org/10.1006/obhd.1998.2781

Leech, G. N. (2006). *A glossary of English grammar*. New York, NY: Columbia University Press.

Love, J., Selker, R., Marsman, M., Jamil, T., Verhagen, A. J., Ly, A., & Wagenmakers, E.-J. (2015). *JASP (Version 0.7.0)*. Retrieved from https://jasp-stats.org/

MacLeod, C., Mathews, A., & Tata, P. (1986). Attentional bias in emotional disorders. *Journal of Abnormal Psychology, 95*, 15-20.

Matlin, M. W. (2004). Pollyanna principle. In R. Pohl (Ed.), *Cognitive illusions: A handbook on fallacies and biases in thinking, judgement and memory* (pp. 257-271). New York, NY: Psychology Press.

Mogg, K., & Bradley, B. P. (1999). Orienting of attention to threatening facial expressions presented under conditions of restricted awareness. *Cognition & Emotion, 13*, 713-740.

O'Brien, K. S., Hunter, J. A., & Banks, M. (2007). Implicit anti-fat bias in physical educators: Physical attributes, ideology and socialization. *International Journal of Obesity, 31*, 308-314. http://dx.doi.org/10.1038/ sj.ijo.0803398

O'Shea, B., Watson, D. G., & Brown, G. D. A. (2016). Measuring implicit attitudes: A positive framing bias flaw in the Implicit Relational Assessment Procedure (IRAP). *Psychological Assessment, 28,* 158-170.

Palermo, R., & Rhodes, G. (2007). Are you always on my mind? A review of how face perception and attention interact. *Neuropsychologia, 45*, 75-92.

Peterson, C. (2000). The future of optimism. *American Psychologist, 55*, 44-55. http://dx.doi.org/10.1037/0003-066X.55.1.44

Rellecke, J., Sommer, W., & Schacht, A. (2012). Does processing of emotional facial expressions depend on intention? Time-resolved evidence from event-related brain potentials. *Biological Psychology, 90,* 23-32.

Roelofs, K., Minelli, A., Mars, R. B., van Peer, J., & Toni, I. (2009). On the neural control of social emotional behavior. *SCAN, 4*, 50-58. doi:10.1093/scan/nsn036

Santesso, D. L., Meuret, A. E., Hofmann, S. G., Mueller, E. M., Ratner, K. G., Roesch, E. B., & Pizzagalli, D. A. (2008). Electrophysiological correlates of spatial orienting towards angry faces: A source localization study. *Neuropsychologia, 46*, 1338-1348.

Schlaghecken, F., & Martini, P. (2012). Context, not conflict, drives cognitive control. *Journal of Experimental Psychology: Human Perception and Performance, 38*, 272-278.

Stürmer, B., & Leuthold, H. (2003). Control over response priming in visuomotor processing: A lateralized event-related potential study. *Experimental Brain Research, 153*, 35-44.

Taylor, S. E., & Brown, J. D. (1994). Positive illusions and well-being revisited: Separating fact from fiction. *Psychological Bulletin, 116*, 21-27. http://dx.doi.org/10.1037/0033-2909.116.1.21

Figure Legends

Figure 1. Stimulus material and task structure. Panel a) shows the two response mappings (each assigned to half of the participants). Panel b) shows a sequence of three trials: first a congruent arrow target, then a negative face target (congruent for participants in the "positive left" mapping condition, but incongruent for participants in the "positive right" mapping condition), then an incongruent arrow target. Panel c) shows the hand stimuli used in Experiment 2 in place of the arrow stimuli.

Figure 2. Results of Experiment 1. Left: mean reaction times (RTs) in milliseconds (ms) on congruent and incongruent trials (top) and RT Simon effects (bottom). Right: mean error rates on congruent and incongruent trials (top) and error-rate Simon effects (bottom). White markers/bars indicate positively valenced trials, black markers/bars negatively valenced trials. ('positive arrows'/'negative arrows' = arrows associated with the same response as the positive/negative face). Triangle markers indicate arrow targets, circle markers face targets. Error bars indicate ± one standard error of the mean.

Figure 3. Results of Experiment 2. Left: Mean reaction times (RTs) in milliseconds (ms) on congruent and incongruent trials (top) and RT Simon effects (bottom). Right: mean error rates on congruent and incongruent trials (top) and error-rate Simon effects (bottom). Error bars indicate ± one standard error of the mean.

Figure 4. 'Positivity Bias' in the Simon task: spatial attention (indicated by the dashed oval) is shifted to the side associated with the 'positive' response (here: the right; upper panels) and away from the side associated with the 'negative' response (here: the left; lower panels). Relative to a hypothetical neutral Simon task without spatial attentional bias (gray bars), stimuli in a Simon task with spatial attentional bias (black bars) will be processed more quickly when they appear on the attended side (top left, bottom right), and more slowly when they appear on the unattended side (top right, bottom left). The graph in the center shows the

resulting Simon effects (incongruent RT – congruent RT) with attentional bias for 'positive' (Pos) and 'negative' (Neg) responses (black bars), relative to a 'neutral' (Neu) Simon effect (gray bar; note that the gray bars in the top and bottom panel are identical, hence there is only one central bar representing a 'neutral' Simon effect).

Figure 5. Reaction times (in ms) for 'positive stimuli' (i.e., 'happy' faces, and non-face stimuli requiring the same response as those; white markers) and for 'negative stimuli' (i.e., 'sad' faces, and non-face stimuli requiring the same response as those; black markers), collapsed across SR-mapping (positive left/positive right) and experiments. Error bars indicate ± one standard error of the mean.

Figure 1

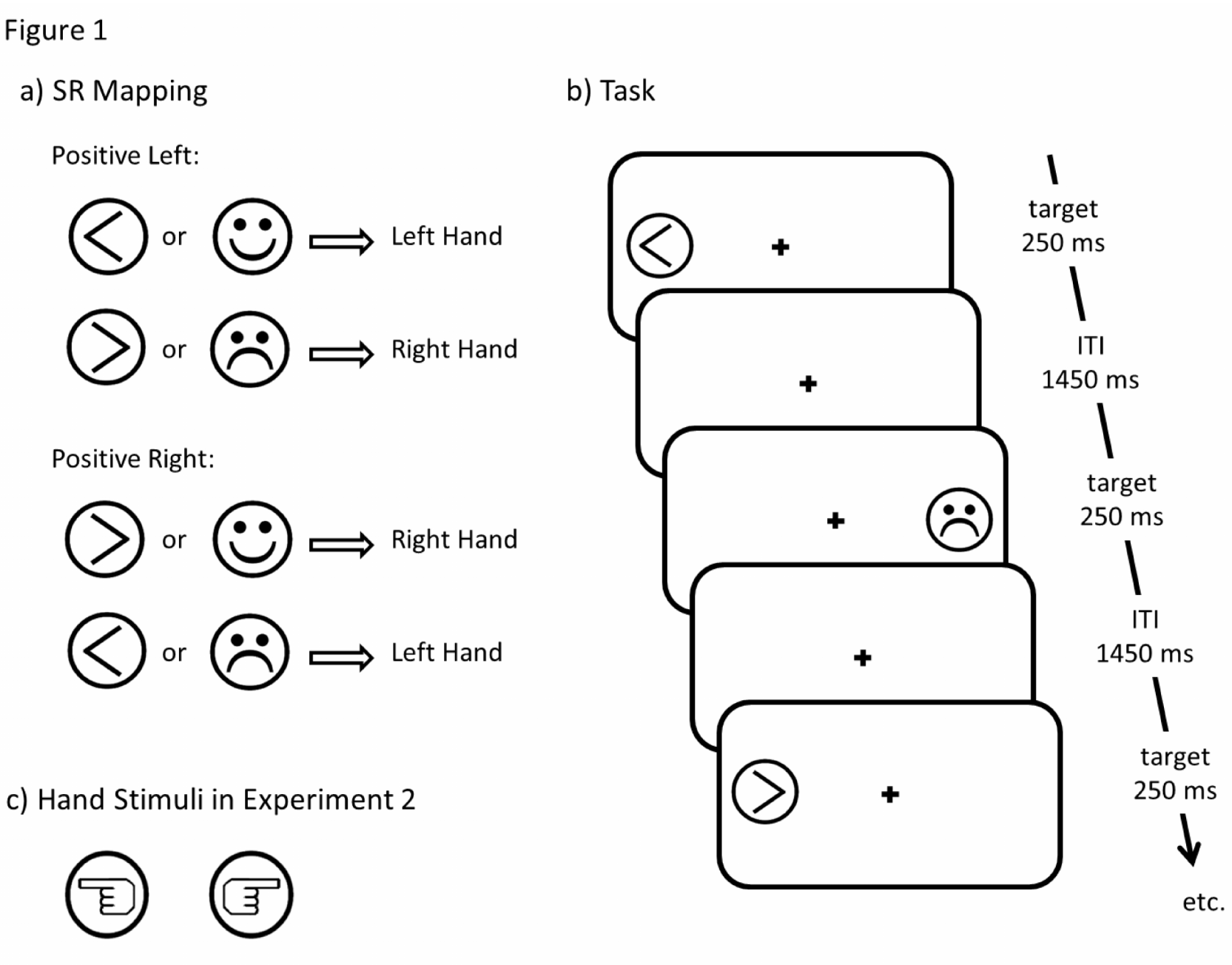

a) SR Mapping
Positive Left:
or
Left Hand
or
Right Hand
Positive Right:
or
Right Hand
or
Left Hand
b) Task
target
250 ms
ITI
1450 ms
target
250 ms
ITI
1450 ms
target
250 ms
etc.
c) Hand Stimuli in Experiment 2

Figure 2

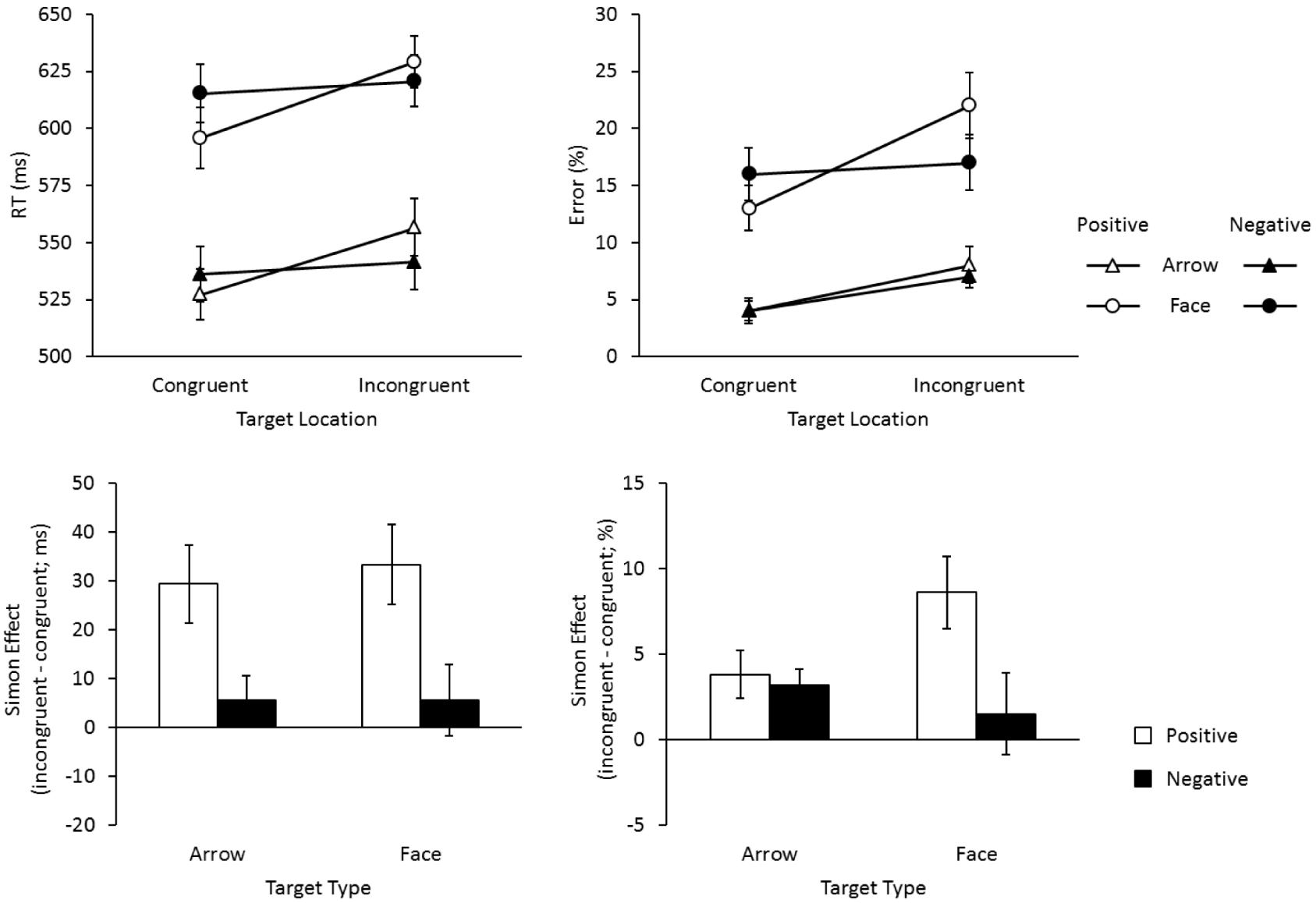

650
625
600
575
550
525
500
RT (ms)
Congruent
Incongruent
Target Location
30
25
20
15
10
5
0
Error (%)
Congruent
Incongruent
Target Location
Positive
Negative
Arrow
Face
50
40
30
20
10
0
-10
-20
Simon Effect
(incongruent - congruent; ms)
Arrow
Face
Target Type
15
10
5
0
-5
Simon Effect
(incongruent - congruent; %)
Arrow
Face
Target Type
Positive
Negative

Figure 3

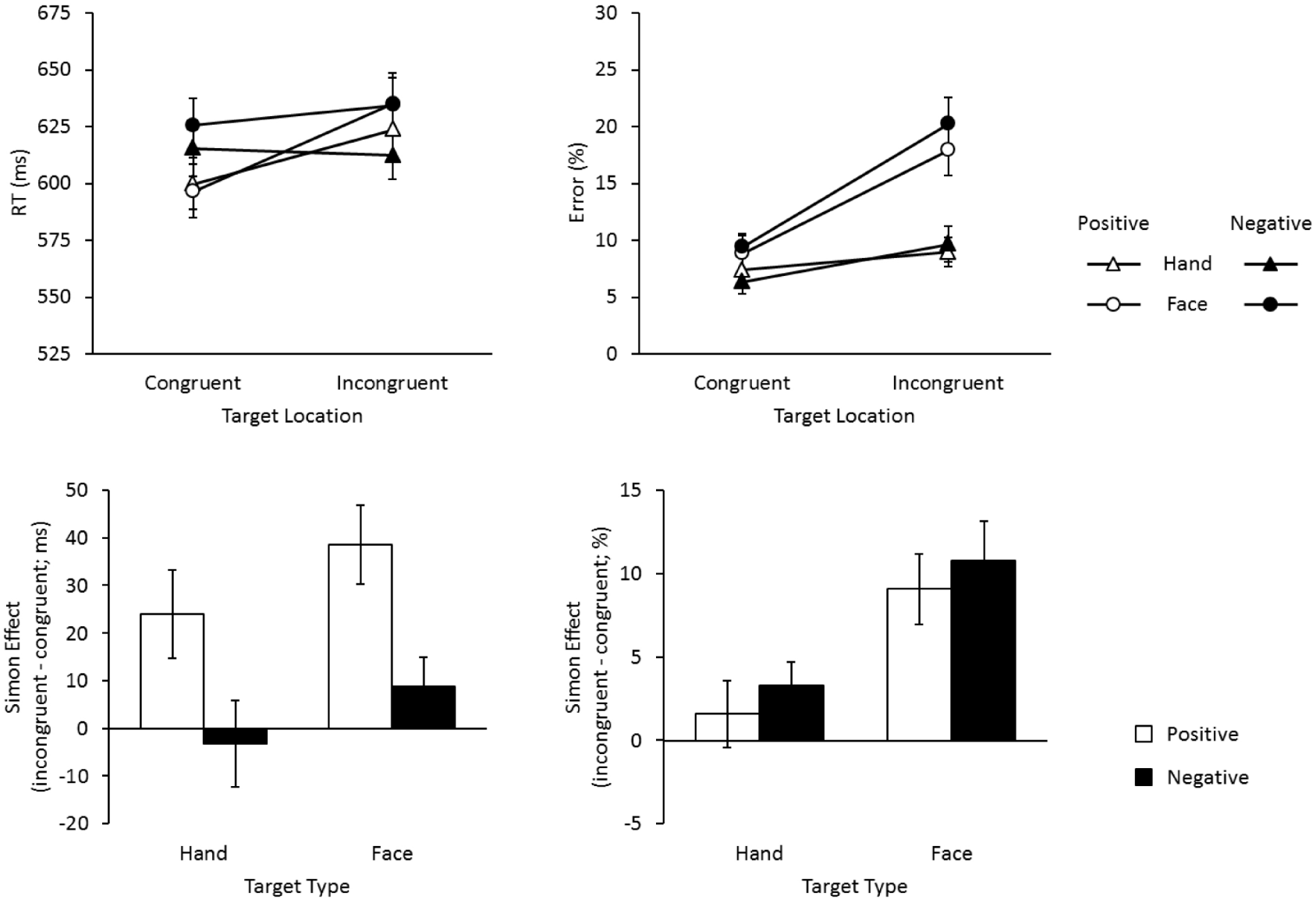

675
650
625
600
575
550
525
RT (ms)
Congruent
Incongruent
Target Location
30
25
20
15
10
5
0
Error (%)
Congruent
Incongruent
Target Location
Positive
Negative
Hand
Face
50
40
30
20
10
0
-10
-20
Simon Effect
(incongruent - congruent; ms)
Hand
Face
Target Type
15
10
5
0
-5
Simon Effect
(incongruent - congruent; %)
Hand
Face
Target Type
Positive
Negative

Figure 4

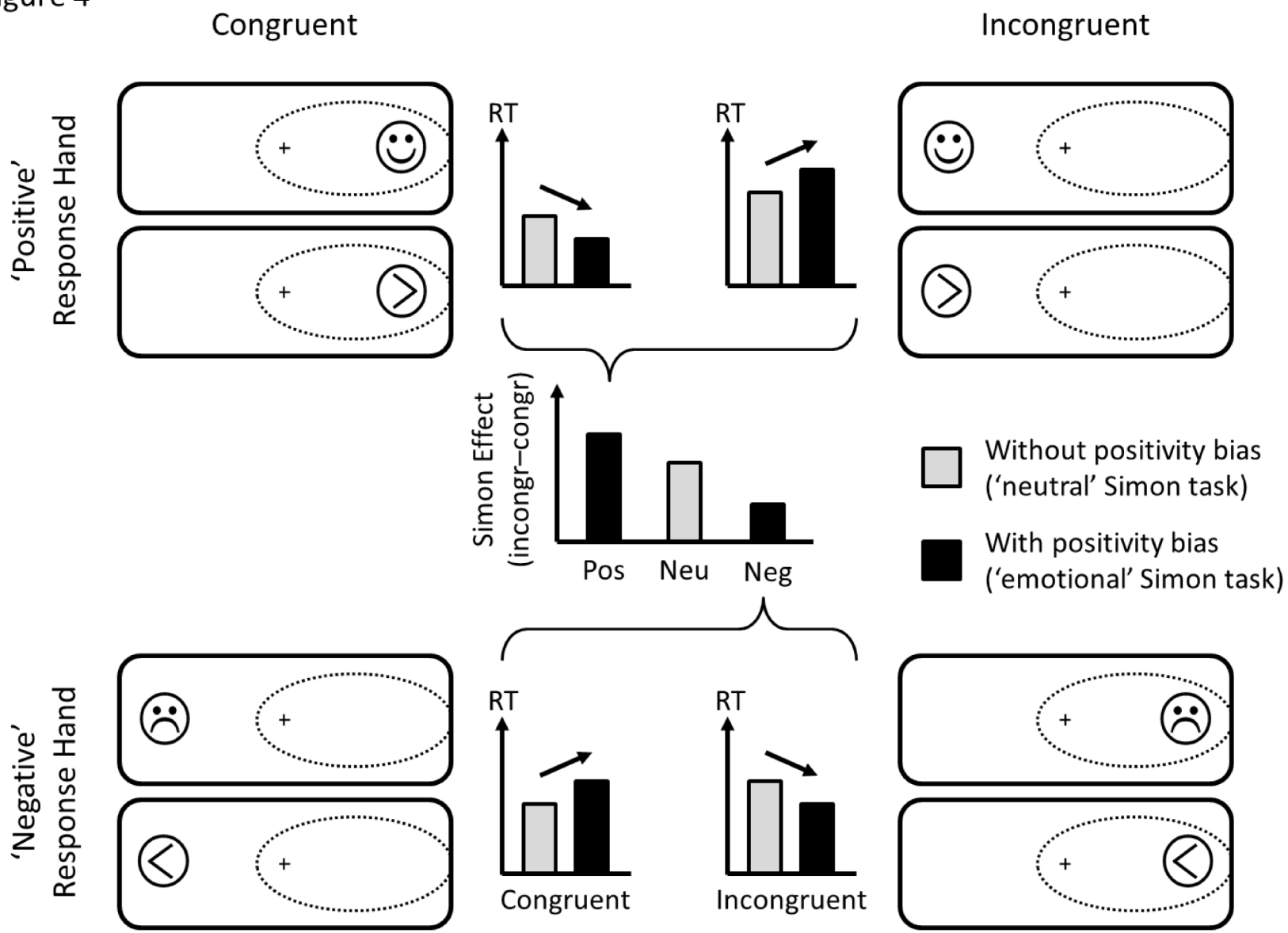
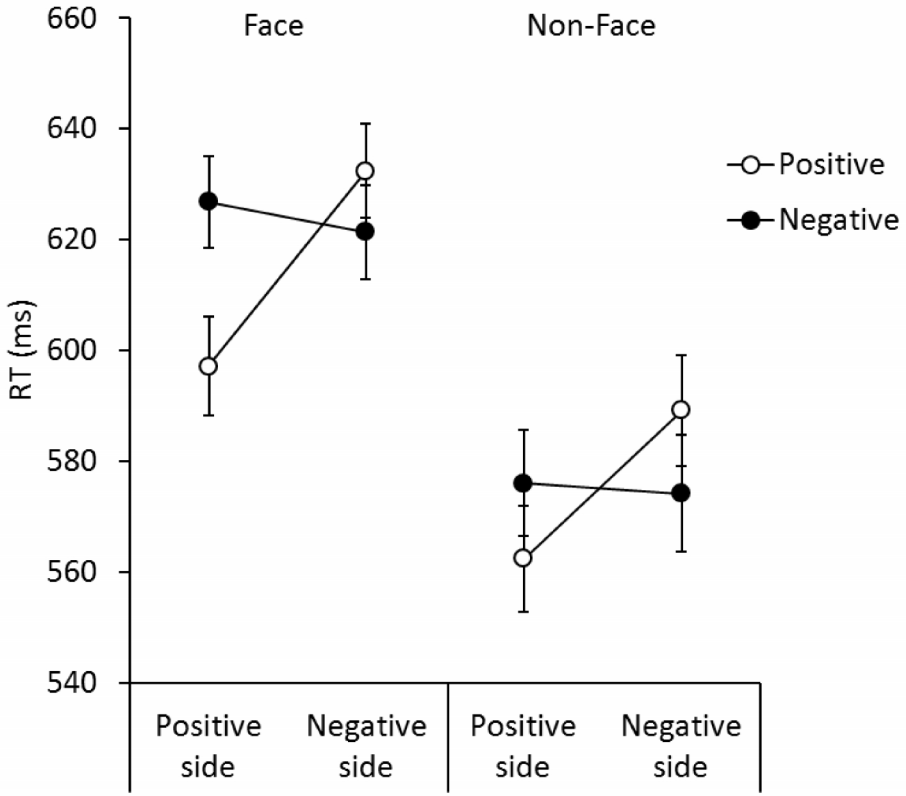

Congruent
Incongruent
'Positive' Response Hand
'Negative' Response Hand
RT
RT
RT
RT
Simon Effect (incongr–congr)
Pos
Neu
Neg
Congruent
Incongruent
Without positivity bias ('neutral' Simon task)
With positivity bias ('emotional' Simon task)

Figure 5


660
640
620
600
580
560
540
RT (ms)
Face
Non-Face
Positive
Negative
Positive side
Negative side
Positive side
Negative side